REMARKS

The Examiner has objected to the specification as containing reference to claim numbers. The Examiner cites as an example the first paragraph on page 1 of the specification. However, Applicants note that this paragraph was deleted in the Preliminary Amendment concurrently filed with the application. Additionally, the third fully paragraph on page 5 of the specification, which references claim 1, was also deleted. Thus, it does not appear that the specification includes any improper references to the claim numbers. Thus, it is respectfully requested that this objection be withdrawn.

Claims 1-13 are all the claims pending in the application. Claims 3 and 4 have been rejected under § 112 (second paragraph) as being indefinite. Additionally, claims 1, 2, 5, 7-10 and 12 have been rejected under § 102(b) as being anticipated by Colombeli, et al., discussed in the Background portion of the application. Additionally, claims 11 and 13 have been rejected under § 103 as being unpatentable over Colombeli, et al.. Further, claim 6 has been rejected under § 103 as being unpatentable over Colombeli, et al. in view of Sirtori, et al.

By way of this Amendment, Applicants have amended the claims to include their overall clarity and to conform with U.S. Patent practice. Additionally, claims 3 and 4 have been amended to address the § 112 (second paragraph) rejection. For the following reasons, it is respectfully submitted that the application is condition for allowance.

Regarding claims 3 and 4 of the application, the reference made to "ε_2" is meant as a general dielectric constant that could be different for each region. Claims 3 and 4 have been

amended to address the issue raised by the Examiner. Accordingly, it is respectfully requested that the § 112 (second paragraph) rejection be withdrawn.

Turning to the prior art rejection, Applicants note that the Examiner maintains that the APL paper discloses a "guide layer being doped in a manner such that the first and second interfaces are capable of supporting plasmon modes, respectively, and the guide layer being of a thickness such as to bring about the accumulation of the plasmon modes in proximity to the first and second interfaces, outside the layer, and substantially a suppression of the plasmon modes, inside the layer".

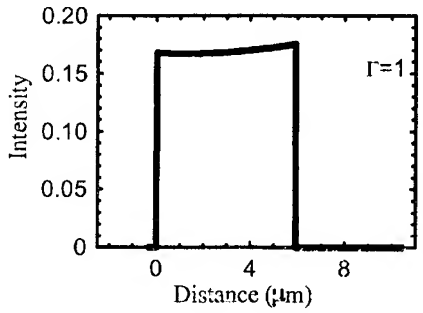
This assertion is respectfully traversed.

Colombelli et al. is certainly considered to represent the closest prior art. It was cited in the present patent application, and it reported the longest wavelength (lowest frequency) quantum cascade lasers (QCL) before the present invention. By incidence, some of the inventors co-authored the APL paper.

As clearly stated in the application, however, and contrary to the THz QCL of the invention, the device described in the APL paper still makes use of the conventional "surface plasmon" waveguide (optical mode based on a simple metal-semiconductor interface), which, as explained also in the application, cannot operate successfully at frequencies smaller than 10 THz. In fact, the lowest operation frequency here reported is 12,5 THz.

The right column of page 2622 of D1 explains that a different waveguide was also tested featuring a highly doped buried layer. What is called "double-sided surface plasmon waveguide" could be mistaken for something analogous to the waveguide concept of the invention. The two

are however crucially different. Here the concept relies on the use of a semiconductor layer as highly doped as possible and quite thick (750 nm is thick for 24 prll wavelength) that, together with a doped substrate simulates a second metallic surface below the active region. The resulting mode is totally encased between the two metallic "hard walls" of surface plasmon with a profile similar to what reported in the following figure.



Clearly the profile is fully different from that of the waveguide of the present invention, where only a thin, doped layer is employed on top of an insulating substrate (see fig. 3 of the present application). It is apparent that the plasmon modes accumulate on both interfaces of the waveguide layer (16). On the contrary, the wavequide layers disclosed in the APL paper have only one corresponding interface which support the plasmon modes, respectively. Accordingly, the confinement factor Γ is about 0,98, which is far larger than that of the device of the present invention (~ 05, see page 10, line 31). On the other hand, the waveguide losses in the device of the present invention are far smaller than those of the device of the APL paper (only some cm-1, see page 9, line 20).

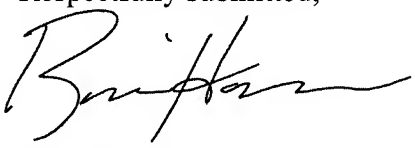
Furthermore, in THz QCL according to the invention it is possible to adjust the doping and thickness of the waveguide layer in order to control the mode penetration and losses.

For some time it was thought that the waveguide of the APL paper would be a possible solution for THz QCL because of the near-unity confinement factor. To date, however, it has never worked for THz lasers, probably because of the large losses [see M. Rochat et al., Appl. Phys. Lett. 78, 1967 (2001)]. Only very recently the concept has found a working implementation in a different form where the bottom layer is really metallic [see Williams B S et al. Appl. Phys. Lett. 83, 5142 (2003)]. The latter requires however a quite complicated and cumbersome fabrication procedure.

In view of the foregoing, Applicants respectfully submit that all the claims pending in the application patentably distinguish over the prior art. Accordingly, it is respectfully submitted that the application is now in condition for allowance. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

Respectfully submitted,



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Date: January 19, 2007